REPORT 20

SWEEP

SOIL AND WATER

ENVIRONMENTAL

ENHANCEMENT PROGRAM

PAMPA

PROGRAMME D'AMÉLIORATION

DU MILIEU PÉDOLOGIQUE

ET AQUATIQUE

Canada

Ontario

SWEEP

is a $30 million federal-provincial agreement, announced May 8, 1986, designed to improve soil and water quality in southwestern Ontario over the next five years.

PURPOSES

There are two interrelated purposes to the program; first, to reduce phosphorus loadings in the Lake Erie basin from cropland run-off; and second, to improve the productivity of southwestern Ontario agriculture by reducing or arresting soil erosion that contributes to water pollution.

BACKGROUND

The Canada-U.S. Great Lakes Water Quality Agreement called for phosphorus reductions in the Lake Erie basin of 2000 tonnes per year. SWEEP is part of the Canadian agreement, calling for reductions of 300 tonnes per year — 200 from croplands and 100 from industrial and municipal sources.

PAMPA

est une entente fédérale-provinciale de 30 millions de dollars, annoncée le 8 mai 1986, et destinée à améliorer la qualité du sol et de l'eau dans le Sud-ouest de l'Ontario.

SES BUTS

Les deux buts de PAMPA sont: en premier lieu de réduire de 200 tonnes par an d'ici 1990 le déversement dans le lac Erie de phosphore provenant des terres agricoles, et de maintenir ou d'accroître la productivité agricole du Sud-ouest de l'Ontario, en réduisant ou en empêchant l'érosion et la dégradation du sol.

SES GRANDES LIGNES

L'entente entre le Canada et les États-Unis sur la qualité de l'eau des Grands Lacs prévoyait de réduire de 2 000 tonnes par an la pollution due au phosphore dans le bassin du lac Erie. PAMPA fait partie de cette entente qui réduira cette pollution de 300 tonnes par an — 200 tonnes provenant des terres agricoles et 100 tonnes provenant de sources industrielles et municipales.

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CONSERVATION TILLAGE EQUIPMENT: AVAILABILITY, UTILIZATION AND NEEDS

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Disclaimer

This research report has been prepared by the Authors for the Ontario office of the Agri-Food Development Branch (Ontario) of Agriculture Canada. The research study described in this report was funded by contract under the Socio-Economic Analysis Component of the Soil and Water Environmental Program (SWEEP).

However, the views and opinions contained herein are those of the authors and do not necessarily reflect the views of Agriculture Canada or the SWEEP Management Committee.

Note: The reader should, when interpreting the results of the farmer and industry interviews, "not" generalize to all Ontario farmers for two reasons. First, the number of persons interviewed was relatively small. This project was an initial effort to determine whether or not a need exists for additional engineering and design work on conservation tillage equipment. Since all segments of the industry were considered important, the number of respondents in each of the four components is small. The project budget determined the total number of respondents who could be interviewed.

Second, the farmers were selected on the basis of their innovativeness and willingness to explore new cropping practices. Most of the respondents are innovators on the "leading edge" of conservation farming. They are not typical of all Ontario cash crop farmers. Many have found relatively satisfactory production systems and are already using equipment which are new or innovative to the majority of farmers.

EXECUTIVE SUMMARY

Introduction

Background

Agriculture Canada commissioned InfoResults Limited to conduct a study of conservation tillage equipment to determine the availability of various machines, their use by farmers and the farmers' needs which are presently not being met. One of the potential constraints to the adoption of conservation tillage practices is the lack of appropriate equipment. This project is a first effort to review the need for and availability of conservation tillage equipment.

Study Objectives

The objectives of the study were to: document the farmers' level of interest in conservation tillage and tillage equipment; determine the availability of different types of machinery; determine what modifications farmers have made; establish what manufacturers have done and are considering; and explore ways the government could assist innovators.

Research Procedures

A sample of 19 farmers, 10 extension personnel, 18 equipment dealers and distributors and 11 equipment manufacturers were interviewed using a standard questionnaire.

Research Findings

Introduction

The conservation tillage equipment was defined to include any equipment used to undertake primary tillage, seed bed preparation, or the planting of crops under limited or no till conditions. Conservation tillage refers to a cultivation system in which 20% or more of the crop residue has been left on top of the ground.

The reader should be careful in drawing definitive conclusions or generalizing too widely from a small sample of individuals. The scale of the study was relatively limited partly because of the exploratory nature of the study and partly due to resource constraints.

Conservation Tillage Equipment Experience

Almost all the manufacturers and dealers had experience in selling conservation equipment. Other major areas of experience with this type of equipment involved manufacture, design and import. More of the extension personnel than the other respondents had more experience in providing advisory assistance and advice to farmers. The types of CTE with which the respondents had the most experience tended to be seed bed preparation and planting equipment.

All the dealers and extension personnel and four-fifths of the farmers were aware of modifications have being made to machines. About one-third of the manufacturers were not aware of such modifications. More respondents mentioned that modifications were made to planters than to other types of machinery.

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Machinery Needs

Fewer of the farmers than extension specialists or dealers believed that existing CTE allows farmers to meet their needs. Generally, all three groups agreed that farmers' seed bed preparation equipment needs are better met than those of planting or weed control equipment. One-third of the farmers say their own conservation equipment needs are not being met. The percentage of each group believing farmers have needs which are not being met were: manufacturers 46%; dealers 39%; extension 100%; and farmers 53%. The greatest unmet needs were: how to use existing equipment and equipment at moderate cost. The major reason given by farmers for other farmers needs not being met was their lack of knowledge.

New Equipment

The overwhelming majority of extension dealers and manufacturers expect new CTE will be developed in the next two or three years to meet farmers needs. Fewer, four-fifths of the farmers, expect new CTE will be developed. Reasons for anticipating new equipment were, an increase in demand, the belief new equipment is being developed and the innovativeness of farmers.

Ninety percent of the manufacturers and all the dealers believed that the market for conservation tillage and seeding equipment will increase. Just over one-quarter of both groups expect an increased demand for traditional tillage and seeding equipment.

More dealers than manufacturers believed modifications are under way to drills and planters. The dealers generally believed the modified equipment will be available in one year but all the manufacturers expected modifications would only be available in two years. The suggested areas of future emphasis when for future CTE were: seed placement/control; fertilizer placement; residue management; and herbicide application.

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Conservation Farming

Almost three-quarters, 72%, of the respondents are quite or generally positive about conservation tillage. The least positive group were the extension specialists. They supported conservation tillage on the basis of reduced water and wind erosion and saving time and money.

Impediments to adoption of CTE, in the opinion of all the respondents were: too risky 33%; lack of awareness 28%; do not believe will work 17%; problems with clay soils 10%; and lack of equipment 2%. Other impediments to adoption volunteered by the respondents were: cost 41%; tradition 25%; and the lack of managerial skills 14%.

Awareness of SWEEP ranged from all the extension personnel, to 63% of farmers, 36% of manufacturers to 28% of dealers. The respondents had few suggestions as to ways by which SWEEP could encourage conservation tillage. Grants to farmers were only supported by six individuals. On-farm demonstrations were favoured by over half of the extension personnel and farmers.

Those aware of SWEEP supported more on-farm trials, using innovative farmers to demonstrate practices, networking, promotion, etc. The role of communication was emphasized.

Conservation Tillage Equipment

The respondents indicated there was less need to promote conservation tillage equipment than the concept of conservation tillage. Ideas suggested included grants, the rental of equipment, promotion and on-farm trials.

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Role of Government

A minority approved of government giving grants to farmers or manufacturers. Actions suggested included a land stewardship program, research and better recommendations regarding specific pieces of equipment.

Conclusions

1. The adoption of conservation farming is not being seriously impeded by a lack of appropriate equipment. A lack of knowledge and traditional farming practices appear to be greater problems than appropriate equipment.

2. The cropping function central to conservation tillage is the planting activity. This is the area where most problems still exist despite the introduction of new planters and drills. Additional research on and adequate directions for operating various planters on different types of soils with varying levels of residue are required.

3. The machinery industry, encompassing manufacturers, importers, fabricators and dealers, appears to be interested in being made more aware of and involved in conservation farming.

4. The primary role of the governments of Ontario and Canada is one of communication to promote conservation tillage.

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Recommendations

1. Agriculture Canada's communication with the farm machinery industry should be increased. Suggest SWEEP personnel establish contacts with the various industry organizations to keep them informed of program activities and research findings. Encourage greater participation by industry manufacturers, importers, and dealers in field trials, equipment evaluations, etc.

2. Increased on-farm demonstrations using various types of planting equipment.

3. Continue land stewardship type programs.

4. Maintain communication activities especially information of the "how to do it" type for farmers.

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INTRODUCTION

Background

Agriculture Canada commissioned InfoResults Limited to conduct a study of the availability of, use by farmers and their unmet needs for conservation tillage equipment. To a significant extent, the adoption of conservation practices by farmers has required changes in their primary tillage machinery as well as adapting seeding and planting equipment to handle crop residues. The availability of appropriate machinery may be one of the constraints on the adoption of conservation tillage practices by Ontario farmers.

Even when a farmer has become convinced of the appropriateness of conservation tillage and related soil conservation practices, they will not be able to implement them if appropriate equipment is not readily available from local dealers. Much of the conservation tillage equipment initially utilized by farmers was standard equipment which had been modified by the farmer or the operator of a local machine shop. They have modified existing equipment and/or added attachments to remove trash or to cultivate a narrow band for a seed bed. Some companies have produced new equipment to meet the growing demand for specialized machines. Some of the equipment being used was imported from areas such as the American Midwest, which began conservation tillage sooner. Some Ontario farmers are understood to have stated that the machinery industry has not responded to their needs as quickly as they would have liked.

Several studies have been completed on the rate of adoption and the characteristics of innovators who are the first to adopt conservation tillage systems. Despite these studies, the availability of conservation tillage and other soil and water

conserving machinery has not been empirically documented in Ontario. Therefore, it was decided to determine what types of equipment are available, what machinery needs of farmers are not being met, what conservation tillage equipment is being considered by manufacturers, what farmers would like and what role governments might play in encouraging conservation farming.

Study Objectives

The general objective of the study was to investigate the availability of farm machinery which will facilitate conservation tillage practices. The specific objectives included:

1. To document farmers' interest in soil conservation, conservation tillage, perceived equipment needs, their priorities regarding new equipment and their perceptions of suppliers of conservation tillage equipment.

2. To determine the availability of different types of conservation tillage machinery in Ontario.

3. To determine what modifications have been made by or for farmers to existing tillage and seeding machinery.

4. To determine what types of changes in tillage and seeding machinery manufacturers have initiated or are considering and when their machines will be commercially available.

5. To suggest ways government agencies may encourage increased creation and adoption of conservation tillage equipment.

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RESEARCH METHODS

Research Strategy

Approach

It was assumed that a study of farmers' conservation tillage equipment needs would require the collection of original data from a sample of farmers, machinery dealers and/or importers and machinery manufacturers. In order to get a more comprehensive understanding of the process and the machinery required to practice conservation tillage, it was decided to also interview extension and other persons involved in conservation programs.

It was assumed that they would provide a more general perspective on the situation and assist in identifying key respondents. Given the exploratory nature of the study, a purposive sampling of key respondents rather than a statistically valid quantitative survey was completed.

Unmet Needs

The research strategy was to concentrate on the perceived unmet needs of farmers who wanted to practice conservation tillage. We determined the needs of conservation prone farmers by:

1. Directly asking a selected sample of innovative farmers what machinery they "needed" for their enterprises;

2. Asking conservation extension personnel and farm machinery dealers what they believe farmers need and what the farmers have indicated they need or would like; and

3. Asking farm machinery manufacturers what conservation tillage machinery they believe farmers need.

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We recognize that the "perceived needs" of farmers are only one part of the equation. Farmers may be unaware of a certain type of new machine which already exists. In some cases, they could readily achieve the desired results by either adjustment to, or by modifying the way they operate existing machinery. A number of potential modifications and operating procedures described in a report entitled, Conservation Tillage Handbook, Equipment Modifications and Practical Tips for Use, Brubacher et al, was used in identifying potential machinery needs.

Machinery Inventory

It was desirable not only to ascertain farmers' perceptions of their machinery needs, but also to determine the availability of existing conservation tillage equipment. An initial inventory of available conservation tillage equipment was prepared based upon contacts with various industry representatives. A complete inventory would require an extensive search of the literature and contacts with a large number of manufacturers. This activity was beyond our terms of reference. We assembled a collection of brochures and illustrative materials of the equipment available in Ontario. This material has been provided to the client under separate cover.

Perceptions

The research procedures allowed the authors to document and directly compare the perceptions of the four groups of respondents regarding farmer's conservation tillage machinery needs. This comparison was undertaken to determine whether or not the manufacturers agreed with the farmers as to what types of machinery

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was needed. We also wanted to investigate if manufacturers were not making some machines because they could not compete with foreign manufacturers. They may not produce a machine because the cost, due to limited demand or unique requirements, would be so high that farmers would not be prepared to purchase it. In effect, specific machines may not be available because of limited potential profits rather than a lack of awareness that farmers would like to purchase this type of equipment.

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RESEARCH DESIGN

Sampling Framework

Introduction

Personal and telephone interviews were conducted with three major groups of respondents, namely farmers, extension personnel, and representatives from the farm machinery industry. These include distributors, machinery dealers and machinery manufacturers. The sampling was purposive rather than random in order to maximize the information collected. We did not want to find that the majority of farmers have very limited knowledge of or they are unable to articulate the types of conservation tillage equipment needs which are not being met. Thus only knowledgeable individuals active in conservation farming were selected for inclusion in the study. See Table 1 for a summary of the respondents interviewed.

Table 1. Sample Framework

Respondents Interviewed	Number
Farmers	19
Extension personnel	10
Equipment dealers and distributors	18
Equipment manufacturers	11
Total	58

Sample Characteristics

Farmers

The farmer respondents were of two types, those interviewed using a questionnaire and those who participated in a group discussion. A total of 19 farmers were formally interviewed, 4 in person and the remainder on the telephone. A group interview was conducted with 16 delegates during the Ontario Soil and Crop Improvement Association annual meeting.

The group interview was conducted with a cross section of delegates from all parts of Ontario. During a breakfast session, they completed a very short questionnaire and participated in a discussion of the need for additional conservation tillage equipment. This group interview assisted in designing the telephone questionnaire. The demographic characteristics of the farmers and other respondents interviewed are shown in Table 2.

Extension Personnel

A total of 10 extension personnel were interviewed. They responded to a structured questionnaire, 7 in person and 3 by telephone. The distribution of extension respondents by employer was: Ontario Ministry of Agriculture and Food, five; Conservation Authorities, four; and one representative of an agribusiness firm. The demographic characteristics of the extension personnel are shown in Table 2.

Equipment Dealers

Eighteen farm equipment dealers and distributors were interviewed, half in person and half on the telephone. A number of the dealers interviewed also operated a farm or were involved in the fabrication or manufacture of conservation tillage equipment. Characteristics of these respondents may be seen in Table 2.

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The generous assistance of the Canadian Farm and Industrial Equipment Institute, the Ontario Wholesale Farm Equipment Association and the Ontario Retail Farm Equipment Dealers Association who assisted in the identification of dealers, who promote conservation tillage equipment, was appreciated.

Equipment Manufacturers

Personal face-to-face interviews were completed with 9 of the 11 equipment manufacturers. The companies represented included both long line multinationals and short line fabricators and importers. The manufacturers were a relatively heterogeneous group with some both building and selling equipment.

The demographic characteristics of the manufacturers interviewed may be seen in Table 2. A number of these individuals were identified with the kind assistance of the Ontario Farm Equipment Manufacturers Association.

Questionnaires

The questionnaires were designed to provide comparable data from the four groups described above. Copies of the questionnaires have been filed with the client. The areas investigated included:

1. Involvement and experience with conservation tillage equipment.
2. Modifications made to existing equipment.
3. Extent to which farmers needs are perceived to be met at this time and types of need not met.
4. Expectations regarding future developments.
5. Awareness of new design activities or activities under consideration.
6. Personal perceptions of conservation tillage.
7. Impediments to increased conservation cropping.

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Table 2. Demographic Characteristics of Respondents

	Respondents								
	Manufacturer		Dealer		Extension		Farmer		Total
	No.	%	No.	%	No.	%	No.	%	
Age									
Under 34	1	9	4	22	5	50	6	32	16
35 - 49	7	64	11	61	5	50	9	47	32
50+	3	27	3	17	0	-	4	21	10
Total	11	100	18	100	10	100	19	100	58
Education									
Less Than High School	1	9	0	-	0	-	1	5	2
High School Grad.	3	27	7	39	0	-	3	16	13
College Grad.	2	18	6	33	0	-	11	58	19
University Grad.	5	46	5	28	10	100	4	21	24
Total	11	100	18	100	10	100	19	100	58
Organization									
Long Line Manufact.	3	27	6	33	-		-		9
Short Line Manufact.	7	64	1	6	-		-		8
Importer	0	-	2	11	-		-		2
Wholesaler	1	9	1	6	-		-		2
Dealership	0	-	8	44	-		-		8
OMAF	-		-		5	50	-		5
Conservation Authority	-		-		4	40	-		4
Agri Business	-		-		1	10	-		1
Farm	-		-		-		19	100	19
Total	11	100	18	100	10	100	19	100	58

8. Awareness of and potential role for SWEEP.
9. Suggested ways governments can encourage the development of conservation tillage equipment.
10. Demographic characteristics.

Data Collection

Interviews

Fifty percent of the interviews were completed by telephone. The remaining half were conducted face-to-face by four experienced professional agrologists. The interviews were completed from February 6 to March 8.

Coding and Tabulation

The completed questionnaires were checked, coded and the data was entered for electronic analysis. Frequency distributions and cross tabulations were completed in a standard data processing package. Given the small size of the sample and the purposive sampling procedures, statistical tests were not considered appropriate. The results should be considered to represent a qualitative rather than a quantitative description of the state of conservation farming in Ontario.

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RESEARCH FINDINGS

Introduction

The survey findings are presented by issue. The responses of the four groups to each question are presented together where possible. In some cases, the questions were group specific. This approach has been selected to allow easier comparison of the responses by the various groups who have an involvement with the use, promotion, sales, design and/or manufacture of equipment.

Conservation tillage equipment was defined to include: any equipment used to undertake primary tillage, seed bed preparation or the planting of crops under limited or no till conditions. The major examples include deep tillage cultivators, plow modification or trash control sweeps and special drills or planters which can place seeds, fertilizers and herbicides into fields where 20% or more of the crop residue has been left on top of the ground.

Generalizing The Findings

The reader should, when interpreting the results of the farmer and industry interviews, not generalize to all Ontario farmers for two reasons. First, the number of persons interviewed was relatively small. This project was an initial effort to determine whether or not a need exists for additional engineering and design work on conservation tillage equipment. Since all segments of the industry were considered important, the number of respondents in each of the four components is small. The project budget determined the total number of respondents who could be interviewed.

Second, the farmers were selected on the basis of their innovativeness and willingness to explore new cropping practices. Most of the respondents are innovators on the "leading edge" of conservation farming. They are not typical of all Ontario cash

crop farmers. Many have found relatively satisfactory production systems and are already using equipment which are new or innovative to the majority of farmers. This is not to say they are not looking for even more effective equipment and production practices. Most will continue to seek innovative ways of farming because they believe there is always a better way to farm.

An attempt to ascertain the opinions of a representative sample of Ontario cash crop farmers would have been quite expensive. Many of the farmers would have quite limited knowledge of or interest in the latest conservation tillage equipment.

Conservation Tillage Experience

Type of Involvement

The manufacturers, dealers and extension respondents were asked to indicate their personal involvement in the design and/or adaptation, manufacture, import, sales, on-farm use or the provision of advice regarding conservation tillage equipment. As may be seen in Table 3 and Figure 1, the majority of the respondents are involved in several ways. For example, almost all the manufacturers and all the dealers were involved in the sale of conservation equipment.

Over half the manufacturers interviewed had also designed or adapted and almost two-thirds of those employed by manufacturers had participated in the fabrication or manufacture of conservation tillage equipment. Only one extension person had design or adaptation experience, and only one had done research in this area. None of the manufacturers or dealers reported any research experience with conservation tillage equipment.

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Table 3. Involvement With Conservation Tillage

Activity	Respondents: Manufacturer No.	Manufacturer %	Dealer No.	Dealer %	Extension No.	Extension %
Design or Adaptation	6	55	0	0	1	10
Manufacture	7	64	0	-	0	-
Import	2	18	5	28	-	-
Sales	10	91	18	100	0	-
Advisory	1	9	4	22	10	100
On-Farm Use	1	9	3	17	6	60
Research	0	-	0	-	1	10
Export	2	18	0	-	0	-
Total Responses	29		30		18	
Total Respondents	11		18		10	

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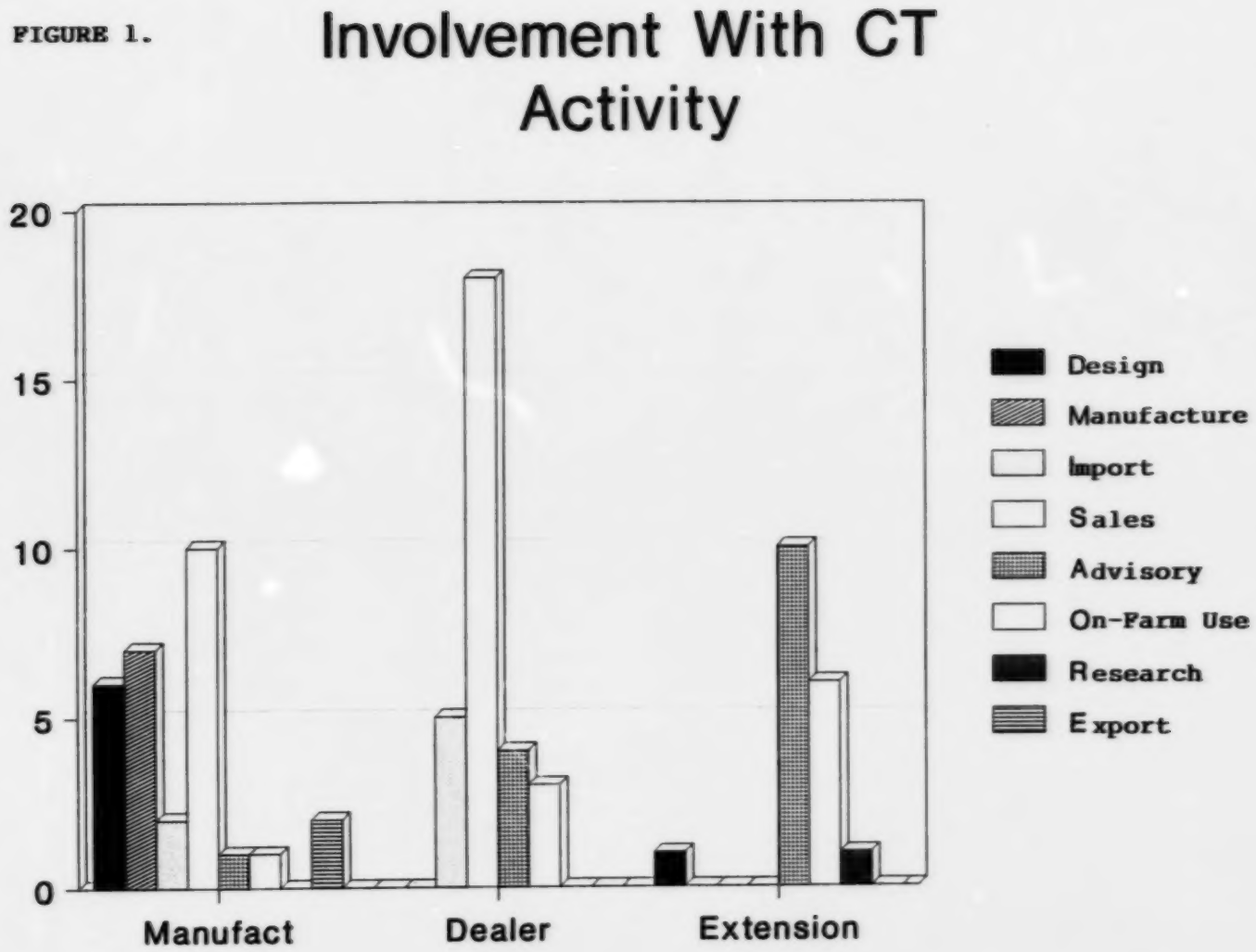
FIGURE 1.


Involvement With CT Activity
20
15
10
5
0
Manufact
Dealer
Extension
Design
Manufacture
Import
Sales
Advisory
On-Farm Use
Research
Export

Experience With Equipment

The manufacturers and dealers were asked what types of conservation tillage equipment they presently manufacture or sell and the farmers were asked what types of equipment they have tried or use on their farm. The responses are shown in Table 4. The percentage of respondents who sell or have experience with the three primary conservation tillage operations, ie. primary or seed bed preparation, planting and weed control are shown. The equipment used for each of the three activities are also listed.

The majority of manufacturers have experience with seed bed preparation and planting, but not weed control equipment. More of the dealers than manufacturers or farmers have experience with all three activities. This is probably due to the fact they tend to sell a wider range of equipment than a single manufacturer would produce or a farmer would utilize. It is noteworthy that all the farmers had conservation planting equipment experience while only 58% reported using seed bed preparation equipment. Note that more farmers have used conservation planters, 16, than drills, 10.

Considering Carrying Or Using

The dealers were asked if there were any other conservation tillage equipment they were considering acquiring for selling in the future. The farmers were asked to identify any conservation tillage equipment they have not used, but are actively considering using on their farm. The equipment to be introduced or tried are summarized in Table 5.

Only a minority of dealers are going to acquire additional equipment lines. Three dealers plan to add drills and two to add sprayers to their lines. There does not appear to be a major expansion into new lines of conservation equipment by the dealers interviewed.

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Table 4. Conservation Tillage Equipment Now Manufactured, Sold or Used

Types	Respondents: Manufacturer No.	Manufacturer %	Dealer No.	Dealer %	Farmer No.	Farmer %
Primary/Seed Bed Preparation	8	73	18	100	11	58
Moldboard Plow	5	45	3	17	1	5
Chisel Plow	3	27	15	83	9	47
Cultivator	4	36	11	61	4	21
Planting Equipment	7	64	15	83	19	100
Drills	5	45	13	72	10	53
Planters	5	45	8	44	16	84
Other	0	-	1	6	0	-
Weed Control	4	36	14	78	14	78
Cultivators	3	27	9	50	2	11
Sprayers	1	9	9	50	14	74
Other	1	9	1	6	0	-
Total Responses	46		117		100	
Total Respondents	11		18		19	

Table 5. Conservation Tillage Equipment Considering Selling or Using in Future

Types	Respondents: Dealer No.	Dealer %	Farmer No.	Farmer %
Primary/Seed Bed Preparation				
Moldboard Plow	1	6	0	-
Chisel Plow	1	6	1	5
Ridge Cleaner	0	-	1	5
Other	1	6	0	-
Planting Equipment				
Drill	3	17	5	26
Planter	1	6	3	16
Other	1	6	0	-
Weed Control				
Cultivator	0	-	3	16
Sprayer	2	11	2	10
Other				
Strip Cropping	0	-	1	5
Stalk Chopper	1	6	2	10
Fertilizer Placement	0	-	1	5
Nitrogen Application	0	-	2	10
Attachments	1	6	0	-
Total Responses	12		21	
Total Respondents	12		19	

More farmers plan to try new drills than other equipment. Three farmers claimed they will try inter-row cultivators to control weeds and the same number new planters. Overall, only a minority of the farmers interviewed plan to try new equipment or practices. This more than likely indicates they are not aware of "better" equipment than total satisfaction with their present system.

Modification of Equipment

Much of the conservation tillage equipment has developed as the result of modifications to existing machines. The addition of larger sweeps, heavier cultivator shanks and teeth or drill openers which will cut through more trash, are examples of modifications which do not require the design of a whole new machine. Much of this effort has been of the trial and error variety because different soils require different adjustments.

The respondents were asked whether they were aware of or had made modifications to existing farm machinery to facilitate conservation tillage and if so, to identify the type of equipment involved. As shown in Table 6, all the dealers and extension personnel and four out of five of the farmers are aware of such modifications. About one-third, 36% of the manufacturers are not aware of modifications for this purpose.

The majority of respondents, 38, report the modification of planters. Eleven reported modifications to chisel plows and 10 reported changes to drills and moldboard plows. In all cases, substantially more persons within each of the four groups reported changes to planters than any other implement. This suggests that available planters have had to be modified to satisfactorily operate with the increased crop cover maintained as a result of reduced tillage. Note that the date or time of the modifications was not investigated. Thus one cannot assume planters still are a major problem from these answers.

Table 6. Awareness Of or Have Made Modifications

	Respondents								
	Manufacturer		Dealer		Extension		Farmer		Total
	No.	%	No.	%	No.	%	No.	%	
Type of Modification									
Planters	4	36	12	75	9	90	13	68	38
Drills	-		3	18	5	50	2	11	10
Chisel Plow	1	9	3	18	4	40	3	16	11
Moldboard Plow	1	9	3	18	5	50	1	5	10
High Clearance Cultivator	3	27	4	25	1	10	1	5	9
Aer-Way Cultivator	1	9	-		-		-		1
Inter-Row Cultivator	2	18	1	6	1	10	3	16	7
Heavier Frames	1	9	1	6	-		-		2
Fertilizer Applications	-		2	13	1	10	1	5	4
Weed Control	-		1	6	-		-		1
None	4	36	-		-		4	21	8
Total Responses	17		30		26		28		101
Total Respondents	11		16		10		19		56

Present Needs

The extent to which existing equipment allows farmers to meet their conservation machinery needs is illustrated in Table 7. The three major crop production activities which are amenable to conservation practices, ie. seed bed preparation, planting and weed control were investigated rather than specific activities.

The dealers and extension personnel were more satisfied with existing equipment than the farmers. A measure of overall satisfaction was created by weighting the quite well, slightly and poorly responses 3, 2 and 1 respectively. The dealers rate existing equipment very highly, the extension people rated it slightly less highly and the farmers were less satisfied. Of the three production activities, the farmer believed that weed control equipment was most in need of improvement.

Needs Not Met

The farmers were asked if they had conservation equipment needs, on their farms, which were not being met. One-third, 32%, said "yes". The six farmers with unmet needs cited the following problems: drills or seed placement problems 3; fertilizer application 2; and one farmer cited each of the following, herbicide application, planters in general and a stalk chopper. All but one of the problems or unmet equipment needs related to planting or herbicide placement.

All of the respondents, including the farmers, were asked if farmers (other farmers) have conservation tillage equipment needs which are not being met. The responses were as follows: manufacturers, 46%; dealers, 39%; extension, 100% and farmers, 53%.

InfoResults

Table 7. Extent To Which Existing Equipment Allows Farmers To Meet Needs

	Respondents					
	Dealers		Extension		Farmers	
	No.	%	No.	%	No.	%
Extent Met						
Seed Bed Preparation						
Quite Well	15	100	9	90	14	88
Slightly	0	-	1	10	2	12
Poorly	0	-	0	-	0	-
Score	3.0		2.9		2.9	
Total Respondents	15	100	10	100	16	100
Planting						
Quite Well	14	100	7	70	12	63
Slightly	0	-	3	30	6	32
Poorly	0	-	0	-	1	5
Score	3.0		2.7		2.6	
Total Respondents	14	100	10	100	19	100
Weed Control						
Quite Well	13	93	7	70	11	61
Slightly	1	7	3	30	6	33
Poorly	0	-	0	-	1	6
Score	2.9		2.8		2.6	
Total Respondents	14	100	10	100	18	100

InfoResults

Note that the farmers were asked if other farmers had unmet needs. Just over half, 53%, believed other farmers had unmet needs compared to one-third of themselves. This perception is probably accurate given the respondents have more experience than average with conservation tillage.

The type of unmet needs cited by the respondents, as shown in Table 8, included a number of related issues as well as specific machinery. The need most frequently mentioned was "how to use the equipment". This suggests that in addition to better equipment, there is a need for increased information on when, where and how various machines should be used and how to adjust them for maximum effectiveness. This response suggests that farmers may already have the appropriate equipment to meet their needs but they do not know how to adjust or operate it under varying soil and conditions.

The cost of the equipment, while not a technical characteristic of conservation equipment, is certainly of concern to dealers and farmers. The respondents also identified better residue management as a need. The equipment most frequently needed were planters. This is consistent with answers to other questions asked of the respondents. The 16 farmer respondents, who believe the needs of other farmers are not being met, claim the major problem is a lack of information, as shown in Table 9. Five respondents say the farmers lack knowledge and require education regarding conservation farming. They and three others, who claim farmers do not have adequate money to purchase equipment, are implicitly acknowledging that the equipment needs are of secondary importance. Two farmers emphasized that home built machinery is superior to that available from manufacturers. Two mentioned that equipment manufacturers do not make adequate profits due to high design costs, short runs and competition from imports.

InfoResults

Table 8. Respondents Perceptions Of The Type Of Farmer's Conservation Tillage Equipment Needs Not Being Met

Type	Respondents*									
	Manufacturer		Dealer		Extension		Farmer		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Planters					3	30	1	9	4	8
Drills					3	30			3	6
Inter-Row Cultiv.					1	10			1	2
Liquid Manure Inject.					2	20			2	4
Residue Management					4	40			4	8
Weed Control			1	11	1	10			2	4
How To Use	2	40	3	33	1	10	5	45	11	21
Dealer Lack Knowledge					1	10	2	18	3	6
Cant't Find			1	11	1	10	1	9	3	6
Cost	1	20	2	22	0	-	3	27	6	12
Wet Conditions					1	10			1	2
Not Willing To Adapt			2	22			1	9	3	6
Other	4	80	2	22	1	10	2	18	9	17
Total Responses	7		11		19		15		52	
Total Respondents	5		9		10		11		35	

* Multiple responses were allowed.

Table 9. Why Other Farmers Equipment Needs Are Not Being Met

Reasons	Farmers
Farmers lack knowledge	5
Manufacturers do not make profit	2
Home built better	2
Lack money to purchase	3
Other	3
No Reply	4
Total	16

Table 10. Type Of Equipment Needs Farmers' Reported To Respondents

	Respondents	
Needs	Dealers	Extension
Planters	-	5
Drills	-	3
Other Equipment	2	-
Residue Management	1	3
Cost	1	2
Fertilizer Placement	1	3
Manure Handling	-	1
Total Needs Reported	5	17
Total Respondents	4	10

Needs Reported By Farmers To Others

The dealers and extension personnel were asked if farmers had reported the need for equipment to them. As may be seen in Table 10, a high proportion of extension respondents, half, reported farmers had said they need better planters. Other farmer needs reported by extension personnel were drills, fertilizer placement and residue management. The dealers claim farmers have said they need equipment for fertilizer placement and residue management.

Expectations Re Equipment

The overwhelming majority of respondents expect new conservation tillage equipment which will meet farmers' present needs will be developed in the next two or three years. All of the extension, 94% of the dealers, 91% of the manufacturers and 79% of the farmers expect new equipment, see Table 11. The farmers are slightly less optimistic than the others interviewed.

When asked why they expect new equipment, the most frequently given answer related to increased demand. Seven of the dealers, two of the extension and three of the farmers believe new equipment is being developed. It is noteworthy that none of the manufacturers made this claim. A number of respondents believed new equipment would be available because the technical problems of designing planters which will operate in relatively heavy crop residues have been solved. See Table 12 for further details.

InfoResults

Table 11. Expect New CTE To Meet Needs Will Be Developed In Two or Three Years

Response	Manufacturer %	Dealers %	Extension %	Farmers %
Yes	91	94	100	79
No	9	6	-	21
Total	100	100	100	100

Table 12. Why Expect New Equipment

Reasons	Responses: Manufact	Dealers	Extension	Farmers	Total
Innovative Farmers	1	2	2	2	7
Follow US Trends	1	1	2	1	5
More Demand	4	7	4	2	17
New Equip Being Developed	0	7	2	3	12
Planting Problems Have Been Solved	2	2	1	4	9
Multiple Use Tools	3	2	0	0	5
Other	0	1	0	1	2
Total Responses	11	22	11	13	57
Total Respondents	10	16	9	13	48

InfoResults

Market Expectations

More of the manufacturers and dealers anticipate an increase in sales of conservation than traditional tillage and seeding equipment in the next two to three years. Just over one quarter of both types of respondents expect an increase in traditional machinery sales while 90% of the manufacturers and all the dealers expect an increase in sales of conservation tillage and seeding equipment. See Table 13.

Modifications Underway Or Considered

Almost half of the manufacturers, 46%, say they are aware of conservation tillage equipment design activities or modifications to existing machines that their company or other companies have underway at the present time. Over two-fifths, 61%, of the dealers claimed similar knowledge.

The type of modifications identified are shown in Table 14. Apparently, more work is being done on drills and planters than any other type of equipment with cultivators being of next in importance. The dealers are considerably more optimistic than the manufacturers as to how long before these modified machines will be available to farmers. Eight of the ten dealers expect modified equipment next year, while all five of the manufacturers say it will not be available for two years, see Table 15.

When asked if new equipment or modifications to existing machines are being contemplated by manufacturers, only two manufacturers, 18%, and two dealers, 11%, said they were. Only one person was willing to identify the type being contemplated, tramline equipment.

Table 13. Market Expectations In Next 2-3 Year

Expect Increase For		Respondents: Manufacturer %	Respondents: Dealer %
Traditional Tillage/ Seeding Equipment	Yes	27	28
	No	73	72
Conservation Tillage/ Seeding Equipment	Yes	90	100
	No	10	-

Table 14. Type of Modifications Underway

Type	Manufacturers	Dealers
Drills/Planters	2	6
Cultivators	2	3
Trash Removers	0	1
All Equipment On-going	1	2
Other	0	1
Total Modifications Cited	5	13
No. of Respondents	5	11

Table 15. When Modified Equipment Will Be Available

Years	Manufacturers	Dealers
One	0	8
Two	5	0
More Than Two	0	2
Total	5	10

InfoResults

Areas of Emphasis

All the respondents were asked what areas of conservation farming should be emphasized in future equipment development. As may be seen in Table 16, equipment associated with planting was emphasized. The four most frequently cited areas were: seed placement, fertilizer placement, herbicide application and residue management. While more manufacturers and farmers rated herbicide application as an area worthy of emphasis, more extension personnel cited fertilizer placement and more dealers cited residue management. Note that the extension people gave many more and the dealers fewer than average answers per person.

Conservation Farming

Introduction

The respondents were asked a series of questions about conservation, conservation tillage and SWEEP in order to ascertain their perception of and attitudes toward conservation farming.

They were also asked what role the two levels of government and particularly SWEEP should play in promoting conservation farming and tillage equipment.

Feelings Re Conservation Tillage

The overwhelming majority, 72%, of the interviewees said they feel quite or generally positive about conservation tillage. A further 19% are positive but have reservations. Only one was negative and two were non-committal. A higher proportion of extension than any of the others had reservations about conservation tillage. See Table 17 for the actual numbers. Figure 2 illustrates the numbers graphically.

InfoResults

Table 16. Areas of Emphasis In Future Development of CTE

Equipment	Respondents									
	Manufacturer		Dealer		Extension		Farmer		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Seed Placement/Control	1	13	4	27	6	60	8	44	19	37
Herbicide Application	5	63	3	20	4	40	4	22	16	31
Fertilizer Placement	2	25	4	27	7	70	5	28	18	35
Residue Management	2	25	5	33	5	50	5	28	17	33
Manure Handling	0	-	0	-	2	20	3	17	5	10
Inter-Row Cultivator	0	-	0	-	3	30	3	17	6	12
Other	2	25	2	25	0	-	0	-	4	8
Total Responses	12		18		27		28		85	
Total Respondents	8		15		10		18		51	

Table 17. Personal Feelings Re Conservation Tillage

Response	Respondents: Manufacturer #	Manufacturer %	Dealers #	Dealers %	Extension #	Extension %	Farmers #	Farmers %
Positive/ Generally Pos.	9	82	12	67	6	60	17	89
Positive w/ Reservations	1	9	4	22	4	40	2	11
Negative	1	9	0	-	0	-	0	-
DK/NR	0	-	2	11	0	-	0	-
Total	11		18		10		19	

infoResults

The respondents when asked why they felt as they did about conservation tillage responded as follows. Of the 44 who were positive to conservation tillage, over half, 52%, said it helps reduce water and wind erosion, 30% said it saves time and money, 9% believed it was environmentally beneficial, and 2% approved because of improvement in the soil structure.

Impediments To Conservation Tillage

The respondents were asked whether or not five specific factors impeded the adoption of conservation tillage by Ontario farmers. They were also asked to identify any other impediments to adoption. The responses are illustrated in Tables 18, Figure 3 and Table 19 respectively.

Awareness of conservation tillage was perceived to be an impediment to its adoption by a minority, 45% of the manufacturers, 33% of the dealers, 10% of the extension and 21% of the farmers interviewed. Even fewer of the interviewees, with the exception of extension personnel, perceive that farmers do not believe it will work than are unaware of conservation tillage. Only one respondent, a manufacturer, believed that a lack of equipment is an impediment.

A substantial minority of dealers and farmers and approximately half the manufacturers and extension respondents said farmers feel conservation tillage is too risky to adopt. Only a minority believed that farmers do not adopt because conservation tillage does not work well on clay soils or livestock farms. Only one farmer supported this reason compared to none of the manufacturers and about one in five of the dealers and extension specialists.

If the above five factors do not impede adoption, the respondents were asked, what does? Their answers are shown in Table 19. The

InfoResults

Table 18. Major Impediments To Adoption Of Conservation Tillage by Farmers

Impediments	Respondents: Manufacturer No.	%	Dealer No.	%	Extension No.	%	Farmer No.	%	Total No.	%
Lack of Awareness	5	45	6	33	1	10	4	21	16	28
Do Not Believe Will Work	0	-	4	22	3	30	3	16	10	17
Lack of Equipment	1	10	0	-	0	-	0	-	1	2
Farmers Feel Too Risky	5	45	4	22	5	50	5	26	19	33
Does Not Work On Clay Soils/ Livestock Farms	0	-	3	17	2	20	1	5	6	10
Total	11		18		10		19		58	

FIGURE 2.

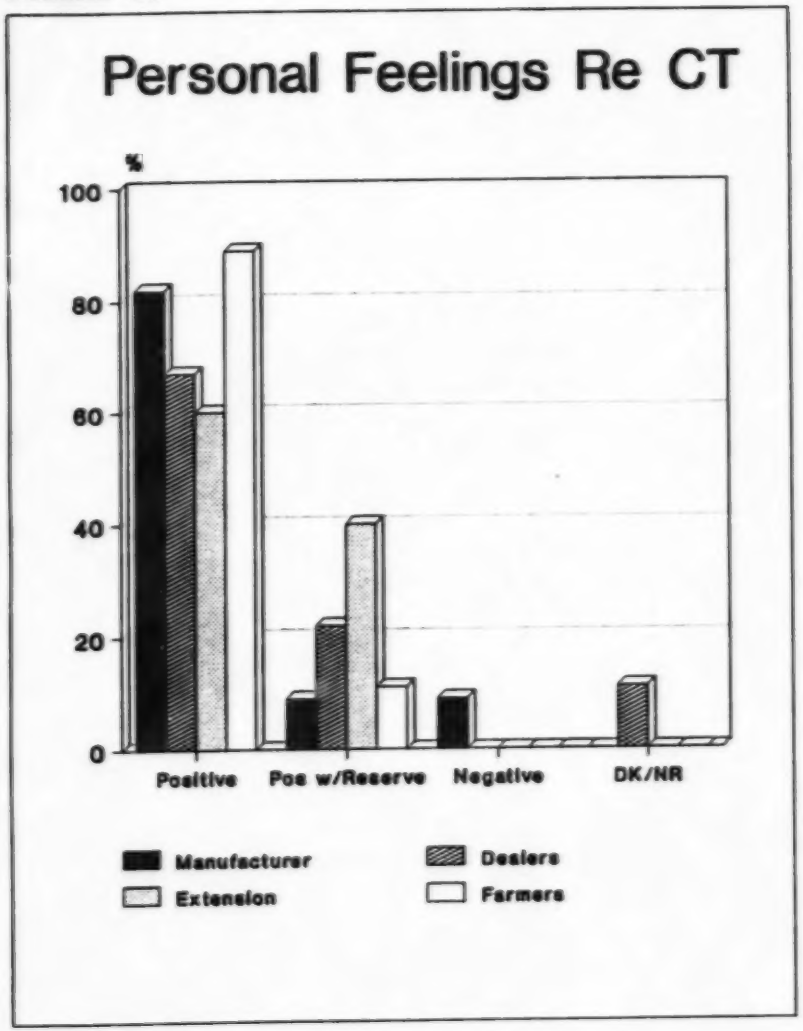

FIGURE 3.

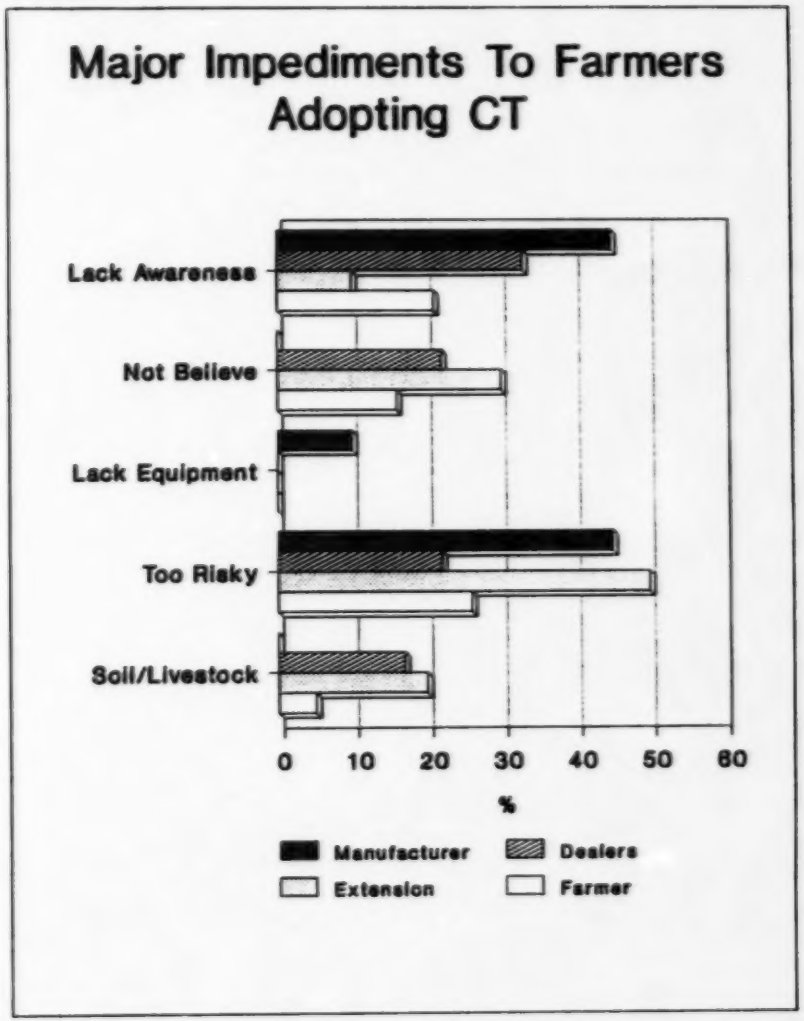

Table 19. Other Impediments To Adoption Of Conservation Tillage By Farmers Volunteered By Respondents

Impediments	Respondents									
	Manufacturer		Dealer		Extension		Farmer		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cost	5	63	8	50	7	78	6	38	26	41
Managerial Skills	2	25	2	13	2	22	3	19	9	14
Tradition	1	13	5	31	2	22	8	50	16	25
Yield Reduction	2	25	2	13	0	-	2	13	6	9
Weather Problems	1	13	3	19	0	-	0	-	4	6
Manure Handling	0	-	0	-	1	11	1	6	2	3
Other	0	-	1	6	0	-	0	-	1	2
No. of Respondents	8		16		9		16		64	

factors in overall order of frequency were: cost, tradition and managerial skills. In all cases, the four groups mentioned cost, more frequently than any other, except for the farmers who cited tradition most frequently. Note this was an open-ended question which allowed the interviewees to give any answer they wished. Three less frequently stated impediments to adoption were: yield reductions; weather problems; and manure handling.

Awareness Of SWEEP

When asked if they were familiar with SWEEP, Soil and Water Environmental Enhancement Program, all the extension, almost two-thirds of the farmers, over one-third of the manufacturers and over one-quarter of the dealers claimed familiarity. See Table 20 for the exact numbers.

Those who were aware of SWEEP were asked what it could do, if anything, to encourage more conservation tillage. Five actions were suggested, then other activities were solicited.

As may be seen in Table 21, all the respondents rejected the suggestion that no action was needed by SWEEP to encourage conservation tillage. One of the respondents said SWEEP should let the market solve the problem. While there was strong support for some action by SWEEP, the respondents did not favour grants.

Grants to farmers were supported by six individuals, only one of whom was a farmer. Grants to dealers and manufacturers were only supported by one person from each of these groups and none of the extension or farmer interviewees. On-farm demonstrations were supported by 60% of the extension and 55% of the farmers. None of the manufacturers or dealers supported demonstrations on farms.

InfoResults

Table 20. Familiar With SWEEP

	Respondents									
	Manufacturer		Dealer		Extension		Farmer		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	4	36	5	28	10	100	12	63	31	53
No	7	64	13	72	0	-	7	37	27	47
Total	11	100	18	100	10	100	19	100	58	100

Table 21. Actions By SWEEP To Encourage Conservation Tillage

	Manufacturer		Dealer		Extension		Farmer	
	No.	%	No.	%	No.	%	No.	%
No Action Needed	0	-	0	-	0	-	0	-
Let Market Do It	1	25	0	-	0	-	0	-
Grants To Farmers	0	-	2	40	3	30	1	10
Grants To Dealers & Manufacturers	1	25	1	20	0	-	0	-
On-Farm Demonstr.	0	-	0	-	6	60	5	55

The 18 respondents who were aware of SWEEP and who made suggestions for encouraging conservation tillage suggested the following: On-farm trials 4; use innovative farmers 3; more networking 3; release of more information 4; increased promotion of conservation 4; and research 2.

When asked why they had made these suggestions, just over half of the 17, 10 said there was a need for publicity and promotion, 4 stressed credibility, 4 visibility and 2 had other reasons. The respondents appear to be saying that SWEEP should emphasize its communication role by means of information programs, disseminating research findings and utilizing demonstration plots on operating farms.

When asked what SWEEP should do to make more conservation tillage equipment available, the respondents answered as is shown in Table 22. The questions used were similar to the ones asked about the more general issue of conservation tillage. Only one-third of the respondents who were familiar enough with SWEEP to answer this question believed there is a need for action, and 20% believe the market should be left to solve the problem. Grants to farmers were cited by 6, only one of whom was a farmer. Grants to dealers and manufacturers were mentioned by three respondents, two of whom were dealers and the other an extension specialist.

Other ways the interviewees suggested SWEEP could encourage conservation tillage equipment use were: the rental of equipment 6, promotion 2, and on-farm trials and encouraging dealers one each.

Five of the farmers and two extension and dealer respondents emphasized that they want to get equipment from machinery dealers rather than through SWEEP initiated programs.

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Table 22. What Role SWEEP Should Play To Make CTE Available

	Respondents							
	Manufacturer		Dealer		Extension		Farmer	
	No.	%	No.	%	No.	%	No.	%
No Need For Action	2	67	0	-	3	33	4	40
Let Market Solve Problem	0	-	1	20	3	38	1	11
Grants To Farmers	1	33	2	40	2	29	1	11
Grants To Dealers & Manufacturers	0	-	2	40	1	17	0	-

Other Roles

Ideas	Manufacturer	Dealer	Extension	Farmer
Rental of Equipment	1	2	3	0
Encourage Dealers	0	0	0	1
On Farm Trials	0	0	0	1
Promotion	0	0	0	2

Role of Governments

The respondents were asked what the governments of Canada and Ontario should do to encourage the development of conservation tillage equipment. This question, which preceded the ones regarding SWEEP in the questionnaire, allowed the respondents to select one of four activities. The percentage of each group selecting each activity may be seen in Table 23 and Figure 4.

The most frequently selected action was farmer grants which was supported by nearly half the respondents. Half the dealers and extension personnel, 39% of the farmers but only 18% of the manufacturers supported farmer grants. These responses are relatively consistent with their open-ended replies to the earlier question summarized in Table 24 and Figure 5. The respondents were also encouraged to indicate other ways the government could assist in promoting the developing of conservation tillage equipment. Among the suggested government roles were: Land stewardship 16; research 12; better equipment recommendations 11; grants to farm organizations 7; and awards to innovative farmers 4.

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Table 23. Role Of Governments To Encourage Development Of CTE

Actions	Respondents: Manufacturer No.	%	Dealer No.	%	Extension No.	%	Farmer No.	%	Total No.	%
Nothing	1	9	2	11	0	-	5	28	8	14
Farmer Grants	2	18	9	50	5	50	7	39	23	40
Manufacturer Grants	3	27	1	5	1	10	1	6	6	11
Other	5	45	6	33	4	40	5	28	20	35
Total	11	100	18	100	10	100	18	100	57	100

Table 24. Other Suggestions For Role of Government

Actions	Manufacturer No.	%	Dealer No.	%	Extension No.	%	Farmer No.	%	Total No.	%
Land Stewardship	0	-	7	39	4	40	5	28	16	32
Farm Org. Grants	0	-	0	-	1	10	0	-	7	14
Research	3	27	0	-	7	70	2	11	12	24
Better Equip Recommend	1	9	4	22	3	30	3	17	11	22
Awards To Innovative Farmers	2	18	2	11	0	-	0	-	4	8
No. of Suggestions	6		13		15		10		50	
No. of Respondents	11		18		10		18		57	

FIGURE 4.

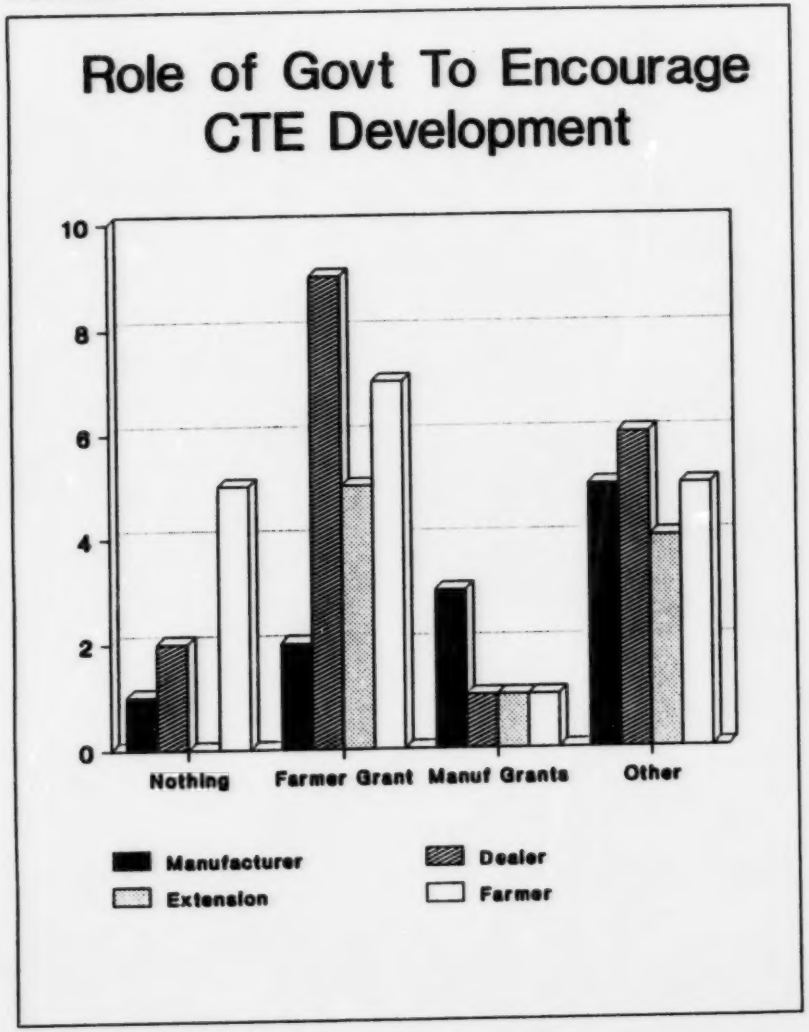
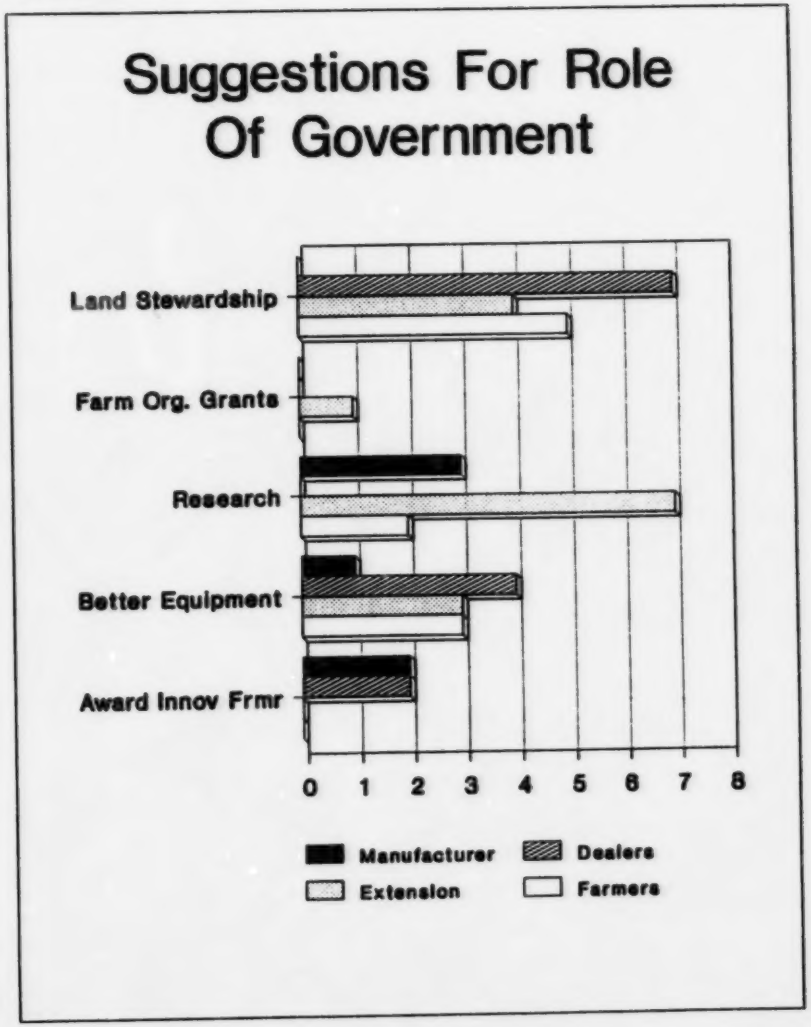


FIGURE 5.



CONCLUSIONS

1. The adoption of conservation farming is not being seriously impeded by a lack of appropriate equipment. A lack of knowledge and tradition appear to be greater problems than appropriate equipment.

2. The cropping function central to conservation tillage is the planting activity. While tillage and weed control are essential, the success or failure of conservation tillage depends primarily upon where the seed, fertilizer and herbicides are deposited in the soil in relation to each other. This is the area where most problems still exist despite the introduction of new planters and drills. The ability of equipment to consistently place seeds, fertilizer and herbicides in the correct relationship despite a layer of residue on the top of the soil has progressed, but additional research is required. There do not yet appear to be adequate directions for operating various planters on different types of soils with varying levels of residue.

3. The machinery industry, encompassing manufacturers, importers, fabricators and dealers, appears to be interested in being made more aware of and involved in conservation farming. Their participation should be encouraged despite earlier reluctance to design and produce some types of equipment. They are presently not well informed regarding government programs in Ontario. All segments of the agricultural industry need to cooperate if conservation farming is to be successful.

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4. The primary role of the governments of Ontario and Canada is one of communication to promote conservation tillage. There is a need to make the manufacturers and dealers more aware of programs, achievements and opportunities. Farmers need more "hands on" information and demonstrations especially in relation to how to plant in residues.

RECOMMENDATIONS

1. Increased communication with the farm machinery industry. Suggest SWEEP personnel establish contacts with the various industry organizations, namely:
    a) The Canada Farm and Industrial Equipment Institute;
    b) The Ontario Wholesale Farm Equipment Association;
    c) The Ontario Retail Farm Equipment Dealers Association; and
    d) The Ontario Farm Equipment Manufacturers Association.

    Keep the organizations informed of program activities and research findings. Encourage greater participation by those industry manufacturers, importers, and dealers in field trials, equipment evaluations, etc.

2. Increased on-farm demonstrations using various types of planting equipment.

3. Continue land stewardship type programs.

4. Maintain communication activities especially information of the "how to do it" type for farmers.

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